

Preparing to Teach



Session Overview

This Lab Module will aid the participant in learning the skills necessary for performing solids analyses on process stream samples in a Unit Lab. A variety of process streams may need to be tested for total suspended solids (TSS) present, that if left unchecked could cause damage to equipment. In addition, waste streams from Process Units, and even effluent streams leaving the Plant bound for a nearby water source, will often contain suspended solids. Environmentally, these waste streams must be monitored to ensure that State and Federal guidelines are met. This module will give the participant an additional troubleshooting tool to aid in making decisions about efficient unit operation.

In this module, the participant will perform TSS analyses to determine the concentration of Carbon present in samples taken downstream of a synthesis gas scrubber system in a Process Unit of a Chemical Plant. The Operator will be asked to make operational decisions based on information obtained in the tests.



Class Preparation Checklist

1. Gather the glassware and equipment needed for the lab exercise.
 - Page 2 in this Lesson Plan
2. Prepare the samples to be analyzed (the number of samples is up to the Instructor and depends on what you want the student to accomplish).
 - Pages 3 - 4 in this Lesson Plan
3. Prepare sample tags (or labels) for the participants to complete for their samples.



Objective(s)

1. Using proper analysis technique, analyze Process Samples that have been prepared by the Instructor for percent solids by weight.
2. Using % solids analysis data, determine whether or not the filters on the Scrubber system are properly removing particulate matter from the scrub water. Samples taken after the filters should contain $\leq 3\%$ TSS.
3. Using % solids analysis results, determine whether or not the filters should be changed in the Process Unit stream feeding the Separation tower. Samples taken after the filters should contain $\leq 1\%$ TSS.



Equipment needed for the Lab Exercise

1. Analytical balance: four-place, electronic, top loading or equivalent.
2. Gooch porcelain crucibles, with perforated bottoms, 25mL capacity, 36mm diameter, 21mm base diameter, with a Gooch crucible adapter for vacuum filtering, such as Coors: #60148 or equivalent.
3. Glass-fiber filter disks without organic binder: Whatman grade 934 AH, 2.1cm, or equivalent. Immediately after opening a new box, put the filters into a desiccator to keep them dry.
4. Suction flask, 500mL.
5. Vacuum source: laboratory vacuum lines, vacuum pump, or water aspirator.
6. Desiccator provided with a desiccant containing a color indicator of moisture concentration such as indicating Drierite.
7. Drying oven, for operation at 103-105° C.



Reagents needed for the Lab Exercise

High purity water, to be used in all rinse operations.



Preparation of Samples for Student Analysis in the Exercise

All samples analyzed in this Lab Exercise should be prepared by addition of a known weight of fine particulate (powdered if possible) carbon to a known weight high purity (or distilled) water.

- 1. Scrubber System Samples** – Preparation of these samples depends on what the instructor wants to accomplish.
(Note: Make sample sizes that at least fill a 4 oz. (approx. 100 mls) bottle. Pint samples can also be made.)

- If you want the student to analyze samples from the scrubber that have not passed through the filters, make them with concentrations $> 3\%$ by weight.

You can set your limits as you desire. For example, if you decide that history should show that the scrubber is operating most efficiently when the TSS in the residue stream is between 5% and 10%, then you can make solutions anywhere in this range for your students. For a 5% TSS solution, just add 5 grams of carbon to 100 grams of distilled water.

Note: A 10% solution of carbon will take a little longer to filter than a 5% solution. If you use TSS concentrations greater than these listed, you may have to devise a way of evaporating the liquid instead of filtering it off.

- If you want the student to analyze samples from the scrubber residue stream after it has passed through the filters, then make them with TSS concentrations $\leq 3\%$. For a 2.5% TSS solution, just add 2.5 grams of carbon to 100 grams of distilled water. (Encourage your students to weigh everything to four places if you have the balances available.)
- 2. Sidestream Tray Samples** – Again, preparation of these samples depends on what the instructor wants to accomplish. Make samples that are at least 4 oz. (~100 mls) in volume.
 - If you want the student to analyze samples that would indicate the filters are still functioning properly, then make them in concentrations of $\leq 1\%$ (see module background information for reasoning). You may want to add 0.35 gram of fine carbon powder to 100 grams of distilled water to make a 0.35% by weight solids concentration. This would, of course be within specifications.
 - If you want the student to recommend changing the filters, then make a solution with a carbon concentration $> 1\%$ by weight.

Teaching the Session

Agenda and Instructor Introduction

Time: 15 minutes

Give students the handout on the Lab Module –
Determination of Total Suspended Solids in Liquid Process Samples

Note: You may want to give this module to students prior to the day of the lab, so they have time to preview the information before class.



Background (See Lab Module – Determination of Total Suspended Solids in Liquid Process Samples)

1. Give students time to read through the background information and simulated situation on pages 1 – 4 of the Total Suspended Solids (TSS) Module.
2. Review the background information and situation information with the students.
3. Answer questions students might have about the two types of Units. Make sure they understand why they are sampling the different points, both on the Scrubber system and in the feed stream for the Separation tower.
4. Explain to the students that you will be giving them samples (the number of samples is up to the instructor) to analyze and that their assignment is three-fold:
 - Determine whether or not the Scrubber Base sample is within operating specifications (Explained in the Module). Is the Scrubber working properly?
 - Determine whether or not the filters for the Scrubber system are doing their job (Explained in the Module).
 - Determine whether or not the filters in the process stream feeding the Separation tower need to be changed.



Activity – Determination of Total Suspended Solids in Liquid Process Samples

Distribute the samples you prepared to the students and allow time for them to perform the analyses, record their data, and make their decisions based on their data.